Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Maturitas xxx (xxxx) xxx

Contents lists available at ScienceDirect

Maturitas

journal homepage: www.elsevier.com/locate/maturitas

The Dark Side of the Moon: Global challenges in the distribution of vaccines and implementation of vaccination plans against COVID-19

Cristina Mesa-Vieira [a,*], Felipe Botero-Rodríguez [b], Andrea Padilla-Muñoz [c], Oscar H. Franco [a], Carlos Gómez-Restrepo [b,d,e]

[a] Institute of Social and Preventive Medicine (ISPM), University of Bern, Bern, Switzerland
[b] Departamento de Epidemiología Clínica y Bioestadística, Pontificia Universidad Javeriana, Bogotá, Colombia
[c] Facultad de Jurisprudencia, Universidad del Rosario. Bogotá, Colombia
[d] Departamento de Psiquiatría y Salud Mental, Pontificia Universidad Javeriana, Bogotá, Colombia
[e] Hospital Universitario San Ignacio, Bogotá, Colombia

ARTICLE INFO

Keywords:
Covid-19
Vaccines
Inequity
LMIC
Global health

1. Introduction

Concomitantly with the start of the pandemic, the pursuit of effective vaccines began and developed with great success, and mass vaccination campaigns commenced by the end of 2020. The first quarter of 2021 saw countries such as Israel, the United Kingdom and the United States advancing at great pace in the vaccination programs, while other countries, mainly in the southern hemisphere, were just starting. By the beginning of April, 30 countries had not received a single dose and only 0.57% of the African population was vaccinated [1]. The lag in the introduction of new immunization strategies between countries is not new. For example, in 2016, only 14% of the low- and middle-income countries (LMICs) had introduced the HPV vaccine in their national immunization plans, while 55% of high-income countries (HICs) had done so already [2]. Indeed, some vaccines have been introduced in LMICs years later than in HICs [3].

Despite the challenges posed by the unequal impact and the long duration of the pandemic, the introduction of a vaccine for the prevention of COVID-19 has awakened feelings of hope in the global population. In this context, the Vaccine Global Access (COVAX) agreement was born as an initiative to ensure equitable global distribution of vaccines [4]. But even with this mechanism, there are multiple risks for unequal administration of the vaccines, so the greatest challenge now will be closing the gaps and mitigating the inequities in access to healthcare that have arisen [3,5,6].

Here we describe some of the barriers that contribute to unequal distribution of vaccines in LMICs (see Fig. 1).

2. New nationalism

Producing and distributing vaccines imply robust infrastructure and technological development, which is why they are usually manufactured in countries with greater resources [7]. The scenario where manufacturing factories are limited exposes a differential context between countries, which means that decisions can be taken unanimously in favour of the manufacturing country [8].

Many countries invested from the beginning to ensure the early delivery of vaccines to their population [8]. Companies also managed the commercial opportunity; for example, Sanofi proclaimed that the United States had the right to a greater batch of pre-purchased vaccines [9]. Similarly, several countries signed Advance Purchase Agreements with vaccine manufacturers to ensure their supply vaccines in early stages [10]. In fact, of the first 10 billion doses to be produced, half have been requested by countries of the European Union and five other countries only [11].

Other signs of this new nationalism are the closure of borders to

* Corresponding author.
E-mail address: cristina.mesavieira@ispm.unibe.ch (C. Mesa-Vieira).

https://doi.org/10.1016/j.maturitas.2021.05.003
Received 11 May 2021; Received in revised form 14 May 2021; Accepted 18 May 2021
Available online 26 May 2021

contain the spread of the virus [12] and the politically based delays in the distribution of vaccines [13], which affected citizens in different ways. The impact of border restrictions could be stronger after the implementation of mass vaccination by the use of "immunity passports" to ease restrictions on individuals who have acquired immunity [14]. Freedom of movement would be granted for residents of countries with greater resources to advance their vaccination campaigns, but it could also change the priorities in the order in which the population should be immunized, with corruption playing a role among those seeking to “skip the line” and creating a “two-tier” classification of citizens.

3. Logistical challenges for the procurement and distribution of vaccines

Immunization programs involve not only the purchase of vaccines, but also logistical challenges such as storage and transport [15]; the formulation of education and awareness strategies [3]; and integration with pre-existing vaccination programs in the population.

The supply process of vaccines is complex, to the extent that logistical issues must be anticipated. Requirements such as access to electricity and adequate equipment to keep vaccines at a certain temperature and at the required standards [15] is already challenging in a wide range of areas in LMICs. In the case of the SARS-CoV-2 vaccine, particularly Pfizer/BioNTech’s, storage at ultra-low temperatures is required, impeding access and distribution throughout vast countries with poor infrastructure [16].

Although there is no clear evidence that vaccine hesitancy is higher in persons of lower socioeconomic status, campaigns designed to deliver information about the vaccination rollout might be further challenged in LMICs. The success of a vaccination program will depend not only on logistical aspects, but also on beliefs, attitudes, knowledge and behaviour of the population (which may vary within and between countries) [3]. In this sense, all the evidence or, in certain cases, misinformation that has been created around certain vaccines can affect LMIC populations and will not affect those already vaccinated [17].

Furthermore, countries with small healthcare capacity and coverage may also face challenges in identifying and contacting persons within high-risk groups that should be prioritized for vaccination. Data management and analytics can speed up rollout, optimize strategies in the chain of supply and track the impact of the vaccination process, but it requires a robust communication infrastructure [18]. This infrastructure and staff specifically trained for the vaccination program are also needed for critical regulatory areas and related functions to safeguard the quality, safety, and effectiveness of the vaccination effort [3]. Keeping up with the administration standards of more than 10 globally approved vaccines, each with different handling requirements [19], may be impossible, logistically and economically, for certain countries.

4. Post-implementation challenges

Another concern is the limited capacity to respond to possible adverse effects of vaccines. It is expected this could affect more people with lower economic income suffering from untreated diseases and risk factors [20]. Furthermore, vulnerable populations have limited access to healthcare services or to vaccination sites with all the resources to react appropriately to adverse reactions. In parallel, care costs relating to adverse events will have to be covered by the local healthcare system and not by the pharmaceutical companies, as stipulated in many existing contracts[5].

Likewise, there is the likelihood that continuous vaccination schemes will need to be maintained, given the duration of immunity and the possibility of new non-susceptible strains. The path that begins for the sake of health may be long and costly, and will requires arrangements at the international level that allow low-cost access in order to avoid leading poorer countries into more financial constraints and ensuring greater equity globally. In this sense, making regional alliances can be useful if they seek having common manufacturers for the production of vaccines at low cost, having patents approved more quickly or simply avoiding greater poverty and inequity at the global level.

5. The role of global health

Global health seeks to improve the health of the world’s population through various practices and the expansion of services for the community, especially in LMICs. This approach, although of key relevance, presents multiple challenges [21]. Projects that aim to reduce inequities in immunization, such as the WHO Global Vaccine Action Plan 2011–2020 [22], have been slowly implemented and, in many cases, require HICs to achieve their vaccination goals before delivering vaccines to LMICs. Therefore, the reduction of inequalities between countries and region must be attempted utilizing alternative strategies.

In response, partnership with other governments and non-governmental entities is fundamental, for example, the WHO Global Vaccine Blueprint Project [23], which has helped develop and implement a global support network to ensure minimum vaccine safety capacity, and the alliances for the achievement of vaccines, such as the COVAX alliance. Hand in hand, it is worth resuming those projects that sought to reduce the gaps between countries, which have decreased

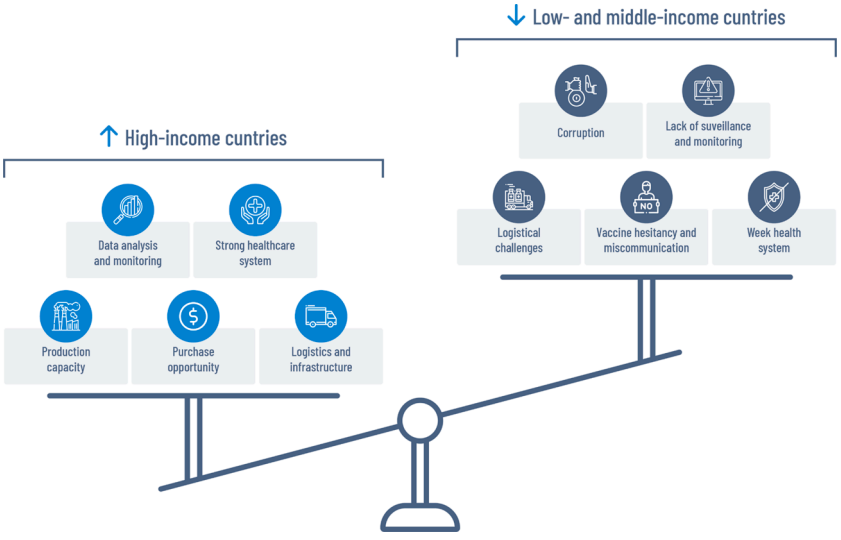

Fig. 1. Global challenges in the distribution of vaccines and implementation of vaccination plans against COVID-19.

since the COVID-19 outbreak [8].

Joint efforts have been seen in previous outbreaks, such as the HIV epidemic, to advocate for affordable drugs. Some activists have called for the lifting of patent restrictions granted to pharmaceutical companies through agreements among World Trade Organization members. However, others argue that capacity building of vaccine production in LMICs is the real issue. This global crisis has further highlighted the need to establish facilities and technology transfer agreements in LMICs to get through this and future pandemics [24]. Only through enhancing LMICs and strengthening capacity development that reduces global inequalities, can the world be on the right path to a definitive solution to the current pandemic.

6. Contributors

Cristina Mesa-Vieira contributed to review and editing of the draft editorial.

Felipe Botero-Rodríguez contributed to drafting the editorial.

Andrea Padilla-Muñoz contributed to drafting the editorial.

Oscar H. Franco contributed to conceptualization, and review and editing of the draft editorial.

Carlos Gómez-Restrepo contributed to conceptualization of the editorial and was responsible for supervision.

Declaration of Competing Interest

The authors declare that they have no conflicts of interest.

Funding

No funding from an external source was received for the preparation of this editorial.

Provenance and peer review

This article was commissioned and was not externally peer reviewed.

References

[1] H. Ritchie, E. Ortiz-Ospina, D. Beltekian, E. Mathieu, J. Hasell, B. Mcdonald, C. Giattino, C. Appel, M. Roser, Coronavirus (COVID-19) Vaccinations, 2021. https://ourworldindata.org/covid-vaccinations (Accessed 22 April 2021).

[2] K.E. Gallagher, D.S. LaMontagne, D. Watson-Jones, Status of HPV vaccine introduction and barriers to country uptake, Vaccine (36) (2018) 4761–4767, https://doi.org/10.1016/j.vaccine.2018.02.003, 32 Pt A).

[3] A. Guignard, N. Praet, V. Jusot, M. Bakker, L. Baril, Introducing new vaccines in low- and middle-income countries: challenges and approaches, Expert Rev. Vaccines 18 (2) (2019) 119–131, https://doi.org/10.1080/14760584.2019.1574224.

[4] M. Eccleston-Turner, H. Upton, International collaboration to ensure equitable access to vaccines for COVID-19: the ACT-Accelerator and the COVAX facility, Milbank Q. (2021) 1–24, https://doi.org/10.1111/1468-0009.12503.

[5] K. Van Tassel, C. Shachar, S. Hoffman, Covid-19 vaccine injuries - preventing inequities in compensation, N. Engl. J. Med. 384 (10) (2021) e34, https://doi.org/10.1056/NEJMp2034438.

[6] J. Sellner, T.M. Jenkins, T.J. von Oertzen, C.L. Bassetti, E. Beghi, D. Bereczki, B. Bodini, F. Cavallieri, G. Di Liberto, R. Helbok, A. Macerollo, L.F. Maia, C. Oreja-Guevara, S. Ozturk, M. Rakusa, A. Pisani, A. Priori, A. Sauerbier, R. Soffietti, P. Taba, M. Zedde, M. Crean, A. Burlica, A. Twardzik, E. Moro, E.A.N.N.-T. Force, A plea for equitable global access to COVID-19 diagnostics, vaccination and therapy: the NeuroCOVID-19 Task Force of the European Academy of Neurology, Eur. J. Neurol. (2021), https://doi.org/10.1111/ene.14741.

[7] WHO, Intensifying vaccine production, Bull. World Health Organ. 98 (5) (2020) 302–303, https://doi.org/10.2471/BLT.20.020520.

[8] G. Nhamo, D. Chikodzi, H.P. Kunene, N. Mashula, COVID-19 vaccines and treatments nationalism: challenges for low-income countries and the attainment of the SDGs, Glob Public Health 16 (3) (2021) 319–339, https://doi.org/10.1080/17441692.2020.1860249.

[9] GIGA, Access to COVID-19 Vaccines and Medicines – a Global Public Good, 2020. https://www.giga-hamburg.de/en/publications/20071517-access-covid-19-vaccines-medicines-global-public-good/ (Accessed 23 April 2021).

[10] C. Local, Burden of Disease vaccine coverage, mapping routine measles vaccination in low- and middle-income countries, Nature 589 (7842) (2021) 415–419, https://doi.org/10.1038/s41586-020-03043-4.

[11] A. Mullard, How COVID vaccines are being divvied up around the world, Nature (2020), https://doi.org/10.1038/d41586-020-03370-6.

[12] UN, Cerrar Fronteras Para Contener El COVID-19 No Es Una Estrategia Sostenible, UN News, 2020 asegura la O.M.S. https://news.un.org/es/story/2020/07/1478001. Accessed 23 April 2021

[13] A.J. Alaran, Y.A. Adebisi, A. Badmos, F. Khalid-Salako, S.K. Gaya, E.B. Ilesanmi, D. Q. Olaoye, A. Bamisaiye, D.E. Lucero-Prisno, Uneven power dynamics must be levelled in COVID-19 vaccines access and distribution, Public Health Pract. 2 (2021), https://doi.org/10.1016/j.puhip.2021.100096.

[14] T.C. Voo, H. Clapham, C.C. Tam, Ethical implementation of immunity passports during the COVID-19 pandemic, J. Infect. Dis. 222 (5) (2020) 715–718, https://doi.org/10.1093/infdis/jiaa352.

[15] U. Kartoglu, J. Milstien, Tools and approaches to ensure quality of vaccines throughout the cold chain, Expert Rev. Vaccines 13 (7) (2014) 843–854, https://doi.org/10.1586/14760584.2014.923761.

[16] K. AboulFotouh, Z. Cui, R.O. Williams, Next-generation COVID-19 vaccines should take efficiency of distribution into consideration, AAPS PharmSciTech 22 (3) (2021), https://doi.org/10.1208/s12249-021-01974-3, 126.

[17] A.L. Wagner, N.B. Masters, G.J. Domek, J.L. Mathew, X. Sun, E.J. Asturias, J. Ren, Z. Huang, I.L. Contreras-Roldan, B. Gebremeskel, M.L. Boulton, Comparisons of vaccine hesitancy across five low- and middle-income countries, Vaccines 7(4) (2019). 10.3390/vaccines7040155.

[18] H.M. Scobie, M. Edelstein, E. Nicol, A. Morice, N. Rahimi, N.E. MacDonald, M. Carolina Danovaro-Holliday, J. Jawad, S.W.G.o. Immunization, Q. Surveillance Data, Use, Improving the quality and use of immunization and surveillance data: summary report of the Working Group of the Strategic Advisory Group of Experts on Immunization, Vaccine 38 (46) (2020) 7183–7197, https://doi.org/10.1016/j.vaccine.2020.09.017.

[19] J. Craven, COVID-19 Vaccine Tracker, 2020. https://www.raps.org/news-and-articles/news-articles/2020/3/covid-19-vaccine-tracker. Accessed 24 April 2021.

[20] K. Wilson, R. Ducharme, S. Hawken, Association between socioeconomic status and adverse events following immunization at 2, 4, 6 and 12 months, Hum. Vaccin. Immunother. 9 (5) (2013) 1153–1157, https://doi.org/10.4161/hv.23533.

[21] C. Montenegro, M. Bernales, M. Gonzalez-Aguero, Teaching global health from the south: challenges and proposals, Crit. Public Health 30 (2) (2020) 127–129, https://doi.org/10.1080/09581596.2020.1730570.

[22] WHO/IVB/18.11WHO, Assessment Report of the Global Vaccine Action plan, World Health Organization, 2018, pp. 1–36. Geneva, https://apps.who.int/iris/handle/10665/276967. Accessed 23 April 2021.

[23] WHO/MVP/EMP/SAV/2019.03WHO, Global Vaccine Safety Blueprint 2.0 Background research, World Health Organization, 2019, pp. 1–42. Geneva, https://www.who.int/vaccine_safety/publications/en/. Accessed 22 April 2021.

[24] W.N. Price, A.K. Rai, T. Minssen, Knowledge transfer for large-scale vaccine manufacturing, Science 369 (6506) (2020) 912–914, https://doi.org/10.1126/science.abc9588.